THE LOCAL AND THE GLOBAL AFFECTIVE STRUCTURES IN MATHEMATICS LEARNING AND THE CONSTRUCTION OF PROFESSIONAL IDENTITY

Inés Mª Gómez-Chacón, Complutense University of Madrid

The approach taken here regarding the topic of 'identity and affect in the development of mathematics teachers' is formulated by the following question, which to be addressed in this Research Forum: 'How can we explore the social and structured nature of affect, motivation and beliefs in mathematics teachers, and how can these inform us about the development of their professional identity?

I assume that affectivity is of fundamental importance in teaching and to teachers for three reasons. Firstly, teachers do experience intense emotions in their teaching; mathematics teachers feel about their pupils, about mathematics as a discipline, about their professional skill, about the actual or likely effect of educational policies upon their pupils and themselves. Feelings are just self-evidently part of experience of being a teacher. Secondly, teachers 'emotions are rooted in cognitions'. I understand cognition from two points of view. On the one hand I consider that one cannot separate feelings from perceptions, affectivity from judgment. Teachers' thoughtful actions in a mathematics class reflect their emotional involvement as well as their moral judgement about education and mathematics. On the other hand, the activity of doing mathematics involves cognitive processes inherent to mathematical thinking (that is, processes that underlie mathematical thinking like specializing, generalizing, conjecturing, convincing). Mathematical activity also involves handling emotional states relative to these processes. Finally, neither cognition nor feeling can be separated from the social and cultural forces which help to structure them and which are in turn shaped by them. Emotion and cognition, self and context, ethical judgement and purposeful action are all intertwined in the reality of teaching.

In the course of this investigation I intend to engage in dialogue with the identity experts (Camilleri, 1990; Gee, 2000; Gómez-Chacón & Figueral, 2007; Sfard & Prusak, 2005), focusing on local and global affect and professional identity in mathematics. My argument will be informed, shaped and founded upon substantial research work and experience on teacher development, as well as on the analysis carried out in teacher training courses.

1. PROFESSIONAL IDENTITY AND THE PROCESSES TO CONFIGURE PROFESSIONALIZATION IN MATHEMATICS

The term *professionalization* is commonly used to refer to the social process whereby individuals acquire formation or professional qualification to perform a particular activity or job. From a *socio-interactionistic perspective*, a social actor participates in this process as her developing self. Here professional development is viewed as the

2010. In ….. (Eds.). *Proceedings of the 34rd Conference of the International Group for the Psychology of Mathematics Education*, Vol. ...., pp. XXX-YYY.,

outcome of negotiation between this social actor and the *professionalization* process, which she also authors. From this perspective, the main goal of professionalization would be the individual's comprehensive development, understood to be intrinsically beneficial for its impact both in global change and social evolution. Based on this idea, and on the assumption that an individual has multiple but integrated context-based identities, professional identity can be understood to be the result of a continuing process of interchange between the individual's participation in her professional domain and professionalization. In this view, *professional identity* is a 'dynamic entity' in which both the individual and the social dimensions are key elements. Teaching identity is built from the meanings associated by each teacher, as both actor and author of this process, with her daily professional activity. Such meanings, in turn, are produced around her beliefs, values, and attitudes toward the world and her own life, including representations, knowledge, motivations and fears, and what being a teacher means to her (Gómez-Chacón, 2006; Frade and Gómez-Chácon, 2009).

Mathematics is involved in the process of an individual's professionalization, that is, in the construction of *mathematical professional identity*, which can reasonably be understood to refer to the meanings this individual develops with mathematics within the scope of her professionalization.

From this perspective we consider that there are key processes in which students will be trained for the development of their identity as future teachers in mathematics:

> -*Identification processes*: consciousness and/or self-identification of the roles and tasks of the mathematics teacher and self-identification.
>
> -*Rupture and continuity processes regarding mathematical learning experience*: positive or negative mathematical self-identity, positive or negative attitudes towards the profession itself.
>
> -*Exploration, commitment and assessment processes*: related behaviour with task and the organization.

We do note that we are working with '*professional knowledge*', and therefore, we have to work with the consideration of designing practical ways that the student-teacher as well as the student must develop so that she can put that knowledge to use in the future with other pupils.

Regarding the teachers' professional development, Shulman (1987: 6) identified a taxonomy of seven types of teacher knowledge (content knowledge, general pedagogical knowledge, etc.), but this list has been critized by different experts because is unstable in practice, and regards factual knowledge as rigid and discrete. We agree with Mason (1998) when he argues from an alternative point of view considering that the teachers' professional development is a growth of structure of attention and the nature awareness. The role of the teacher is to create conditions in which students experience a corresponding shift in the structure of their attention,

whereby they become aware of acts and facts of which they were previously unaware. When we think in terms of awareness, it is possible to see how teaching is itself a path of personal development.

In our proposal of teacher training, where the emotional dimension has been integrated in pre-service and in-service programs of professional development) (Gómez-Chacón, 2000a and 2008), we had articulated knowledge, domains, and method in a three-fold ongoing dimension:

1. Education of awareness of themselves: to activate internal process about personal experiential learning.

2. Education of awareness of discipline: competence in the use of the processes of mathematical enquiry, understanding of the content of mathematics and the area to which it is being applied.

3. Education of consciousness in accompanying others: learn to teach and how to develop the children's awareness in action.

Let us consider then how the local and the global affective structures in mathematics learning, in the framework of studies in affect, allow us a conceptualization and operationalization of this view.

2. TWO STRUCTURES OF THE AFFECTIVE DIMENSION IN THE INDIVIDUAL: LOCAL AND GLOBAL

In order to incorporate the affect in a systematical way in the professional development of teachers I propose to consider two structures of affect: a local and a global.

In the studies conducted by Goldin (2000) and also in my own research studies, (Gómez-Chacón, 2000b) it is revealed that in order to understand the affective reactions of students towards mathematics, it is not enough to observe and know the stages in the process of the change of sentiments or emotional reactions during problem solving ("*local affective dimension*"), or to detect cognitive processes associated with positive or negative emotions. We need to contextualise their emotional reactions within the social reality which gives rise to them. The "*global affective dimension*" is understood as a result of the paths followed by the individual in the local affective dimension. These paths are established with the cognitive system and they contribute to the construction of the general structures of one's self-concept as well as the beliefs about mathematics and the learning of mathematics.

It is well known that many student-teachers have affective structures that impede mathematical learning resulting in the global affect known as "math anxiety" and how this affects their professional identity. But there are few proposals that suggest or explain how to find a reasonable way of transforming these structures into more efficacious ones.

In my present research I am seeking to study mechanisms of change in global affective structures pertaining to mathematics. In what follows I illustrate this point with some examples.

3. HOW TO DEVELOP MECHANISMS OF CHANGE IN GLOBAL AFFECTIVE STRUCTURES IN PRACTICE

In the previous section when I indicated that in professional development the key is the *rupture and continuity processes regarding mathematical learning*, (healthy or conflicting mathematical self-identity; positive or negative attitudes towards the profession itself), we are focusing in global affect structure. Teachers' ways of being strongly influence the students' mathematical identities, especially in what concerns their feelings, beliefs, motivation and self-esteem. This statement was confirmed in research which was conducted on a mathematics class of 52 student- teachers in a large urban university in Spain, in order to explore identity and affect in mathematics education (see Frade and Gómez-Chácon, 2009). The aim of the study was to investigate the values attributed by these students both to mathematics and mathematics education, and to the possible relationships between those values and the development of their professional identities as future teachers. These relationships are analyzed in a series of case studies, in terms of the following factors: personal experience with mathematics, self-image and self-esteem, professional experience, motivation, self-sufficiency and career expectations. The findings showed that, further to the relationships identified between values and professional identity, these students' personal views about mathematics, their mathematical identities at school and their professional attitudes, vocation and motivation played a crucial role in the type of values they attributed to mathematics teaching and learning. Their notions about their ability to learn to teach were identified as an area meriting fuller exploration.

In pre-service programmes of professional development, one special theme in the syllabus was to foster the awareness of themselves and to explore the individual global affect structure. For that purpose, the trainer worked on three factors about past and present events. These factors were the following:

1 Return to learning experience without assessments.

2. Provide attention to emotions, beliefs and values arising from the learning and teaching mathematics.

3. Re-evaluation of the student-teacher experience, establishing links with positive elements of their past experience (association), integrating new experiences (integration), verifying forms of action (validation) and making them own (appropriation). This model has been adapted to mathematic learning from one used by Boud and Walker (1993) for study of barriers to reflection on experience.

Moreover, the analysis of studies on human understanding and the consciousness structures gives us a categorization of these "awareness level": experience, understanding, judgement and decision, levels where feelings and emotional states are heavily involved. Some feelings back these operations easily, while others are obstacles to his real performance. For that reason, I consider so relevant the meta-affect dimension (or awareness of emotional activity to refer to the awareness of one's own emotions and their management).

My proposal for student-teachers development training requires of them to follow a method that involves two kinds of movements. First what I call 'bottom-up'. This method enables the student-teacher to develop his capacity of choice mediated by mathematical knowledge. It is bottom-up because the development movement is from experience to growing understanding, to balanced judgement, to fruitful courses of action, to new fruitful situations, which give rise to new understandings, better founded judgements and more enriching courses of action. But there is also development from 'top-to-bottom'. It must be noted that these processes should be carried out and integrated within the exercise of mathematical knowledge.

4. ADDING EXPERIENCE

The content of this paper attempts to show how to build bridges between research on affect and the professional development of mathematics teachers. Recent research could be more useful when more connections are established between the intuitions stemming from basic research and the studies on improving practice. I have proposed some suggestions for advances regarding the local and global structure in the affect issue and the interaction between affect and professional identity.

Helping teacher students to discriminate between the different processes will make these processes more accessible to intentional use and easier to communicate. Many of the teacher students will not have such processes in their repertoire or be aware of their benefits and purpose. Mathematical identity and the dynamic sense of personal identity are closely related. Mathematical identity refers to a global affective structure, contributes to one's personal sense of self ("who I am in relation to mathematics", or to the part that mathematics plays in building "who I am". The data gathered suggest that students' identification with their profession underlies their affective reactions to both their training and the settings in which it takes place. Yet they also indicate that identification does not suffice; education students grow and develop only when they also "come to grips with themselves" (self-understanding or dynamic sense of personal identity), a process in which key concepts such as self-image and self-esteem, motivation and self-efficiency, and career expectations all intervene.

REFERENCES

Boud; D. & Walker, D. (1993) Barrier to reflection on Experience. In D. Boud; R. Cohen and D. Walker (Ed.). Using experience for learning. The society for reseach into Higher Education and Open University Press, pp. 73-86.

Camilleri, C., Kastersztei, J., Lipiansky, E.M., Maleswska-Peyre, H., Taboadaleonetti, I., Vasquez, A. (1990) Stratégies identitaires. París: Presses Universitaires de France.

Frade, C.; Gómez-Chacón, I. Mª (2009). Researching Identity and Affect in Mathematics Education. (In Tzekaki, M., Kaldrimidou, M. & Sakonidis, C. (Eds.). Proceedings of the 33rd Conference of the International Group for the Psychology of Mathematics Education, Vol. 1, p.376. Thessaloniki, Greece: PME.)

Gee, J. P. (2000) Identity as an analytic lens for research in education, Review of Research in Education 25, 99–125.

Goldin, G.A. (2000). Affective Pathways and Representations in Mathematical Problem Solving. Mathematical Thinking and Learning, 17(2), 209-219.

Gómez-Chacón, I. Mª & Figueral, L. (2007). Identité et facteur affectifs dans l´apprentissage des mathématiques, Annales de Didactique et de Sciences Cognitives, IREM Strasbourg, Vol. 12 , 117-146.

Gómez-Chacón, I. Mª (2000a). Matemática emocional. Los afectos en el aprendizaje matemático. (Emotional Mathematics. Affects in Mathematics Learning) Madrid: Narcea.

Gómez-Chacón, I. Mª (2000b). Affective influences in the knowledge of mathematics, Educational Studies in Mathematics, 43: 149-168.

Gómez-Chacón, I. Mª. (2008). Suggesting practical advances in the research on affect in mathematical learning. In ICME-11, 11th International Congress on Mathematical Education. (http://tsg.icme11.org/tsg/show/31).

Mason, J. (1998) Enabling teachers to be real teachers: necessary levels of awareness and structure of attention, Journal of Mathematics Teacher Education, 1, 243-267.

Sfard, A. & Prusak, A. (2005). Telling identities: In search of an analytic tool for investigating learning as a culturally shaped activity. Educational Researcher, 34(4), 14-22.

Shulman, L. (1987) Knowledge and teaching: Foundations of the new reform. Harvard Educational Review, 57 (2), 4-14.